

FOSSIL BIRDS FROM SOUTHEASTERN ARIZONA.

By ALEXANDER WETMORE,

Of the Biological Survey, United States Department of Agriculture.

During February, March, and April, 1921, Dr. J. W. Gidley, assistant curator of fossil mammals, United States National Museum, made an extensive collection of fossils from newly discovered beds in the upper San Pedro Valley, Cochise County, Arizona. Among rich deposits of mammalian remains were found a small number of bones of birds, all considerably broken, that Doctor Gidley has kindly placed in the hands of the writer for study; those that may be identified with any degree of certainty are described in the pages that follow.

The first locality where excavations were made was in a wash draining into what are known as the Curtis Flats (near the Curtis Ranch), in Sec. 25, T. 18 S., R. 21 E., a point about 14 miles southeast of Benson. Bird remains from this site, few in number, are dark slate in color, and have been considerably crushed and broken. They include the following:

Odontophoridae (indeterminate).

Chloroenas micula, new species.

Fringillidae (indeterminate).

More extensive collections were secured at a second site in a quarry on Sec. 22, T. 17 S., R. 20 E., a point about 2 miles south of Benson. A considerable excavation here yielded a large quantity of fossil material among which was a considerable number of bones of birds. These, though fairly fossilized, are almost as light in color as natural bone. The specimens are all small and were secured, with many remains of other small vertebrates, by careful search in unconsolidated material.

The list of identified specimens from this quarry is longer than that from the first point worked, as it includes the following:

Colymbus, species.

Querquedula, species.

Dendrocygna eversa, new species.

Branta minuscula, new species.

Anatidae (indeterminate).

Colinus, species.

Gallinula, species.

Micropalama hesternus, new species.

Corvus, species.

Junco, species.

Fringillidae (indeterminate).

A few bones were secured from a point one-half mile south of the second quarry (mentioned in the preceding paragraph) at a distance of $2\frac{1}{2}$ miles south of Benson. A limited excavation here revealed various mammalian bones (among them remains of a mastodon of Pliocene age), but yielded only one bird, a specimen nevertheless of great interest. It is identified as follows:

Agriocharis, species.

Following his preliminary examinations of the mammalian remains with which these bird bones are associated Doctor Gidley now considers these Benson beds as upper Pliocene, a supposition that is not controverted by the avian fossils. In the four forms of birds described as new from these deposits are three species of aquatic or littoral habit, a tree-duck, a small goose, and a sandpiper, not one of which has been reported from the first interglacial deposits at Fossil or Silver Lakes, Oregon, noted for their wealth of water fowl remains. A fourth form, the ocellated turkey (*Agriocharis*, species) in its modern phase (*Agriocharis ocellata*) is restricted to a tropical or subtropical climate, so that it may be supposed that its fossil representative existed during a period marked by element climatic conditions.

The make-up of the avifauna of these deposits is of some interest. Water-birds outnumber those that frequent dry land to a considerable extent. They include a grebe, several ducks, a small goose, a sandpiper, and a gallinule. Among other groups the gallinaceous birds are represented by two quails and a peculiar turkey, the latter not reported heretofore from the limits of the United States. A pigeon, a small raven, a junco, and at least three additional finches complete our tale of the bird life of this period. It is noteworthy that the tree-duck, goose, and pigeon described are all smaller than other known representatives of their respective genera.

The drawings illustrating this report have been prepared by Miss Ludwicka Wieser.

Family COLYMBIDAE.

COLYMBUS, species.

The head of a coracoid unearthed two miles south of Benson comes from a grebe of this group, probably from one near *C. nigricollis*. The bone differs in conformation from that of *Podilymbus*, but agrees

in form and in size with that of the eared grebe. It is distinctly larger than that of *C. dominicus* and is smaller and less robust than the coracoid of *C. auritus*.

Family ANATIDAE.

QUERQUEDULA, species.

This genus of teals is recorded on the basis of the distal portion of a left metacarpal, a badly broken right metacarpal in two parts, and two fragmentary ulnas exhumed two miles south of Benson. The fragments in question agree rather closely in contour with *Querquedula discors*, but are slightly larger and vary in minute details of outline. Until a larger series of *Q. discors* and *Q. cyanoptera* is available to demonstrate individual variation in this genus I do not care to assign these specimens a specific name. It is highly probable that they come from a species now extinct.

DENDROCYGNA EVERSA, new species.

Characters.—Proximal part of humerus similar to that of *Dendrocygna bicolor* (Vieillot) but smaller; shaft more sharply ridged at upper end on posterior surface; deltoid ridge extending parallel to line of shaft, reaching to base of tuberculum externum: crista inferior forming an acute angle with side of shaft; caput humeri relatively thicker, with more pronounced overhang on posterior surface.

Description.—Type, Cat. No. 10547, U.S.N.M., proximal half of right humerus (figs. 1 and 2), collected by J. W. Gidley, April, 1921, in quarry on Sec. 22, T. 17 S., R. 20 E., two miles south of Benson, Arizona. Upper Pliocene.

Shaft slender, slightly elliptical below nutrient foramen, becoming strongly triangular at level of crista superior, and continuing thus to head; nutrient foramen located on lower side; shaft becoming sharply ridged at level of lower edge of crista inferior, and continuing thus to base of humeral head, where the ridge merges into a rounded surface; deltoid ridge beginning at margin below lower end of crista superior, and passing in a slight curve obliquely forward, interrupted for the space of 5 millimeters in center, and then continued as a well-marked ridge that broadens to disappear at lower margin of articular surface of tuberculum externum; tuberculum externum elevated, with articular surface extensive, triangular in form, excavated slightly, delimited externally by a sharp angle, and projecting proximally beyond lower margin of caput humeri; caput humeri relatively small, contracted toward external tubercle, ex-



FIG. 1.—PROXIMAL PORTION OF HUMERUS (TYPE) OF *DENDROCYGNA EVERSA*, POSTERIOR VIEW. (NAT. SIZE.)

panded on anterior and posterior faces, on latter forming a shelf-like overhang, that, after turning in a rounded point continues at a right angle over incisura capitis to merge at the anterior end of this groove with the other, more rounded, margin of the head; tuberculum inferior elevated slightly beyond level of humeral head, strong, excavated slightly for a prominent triangular muscle attachment on upper side of point, outer margin rounded below in a gradually sloping obtuse angle to merge into crista inferior; incisura capitis deep, narrow, rounded at bottom, with perpendicular walls on either side; a rounded depression below humeral head; distal inner margin of inferior tubercle produced over fossa subtrochanterica, the line of the margin slightly concave, the



FIG. 2.—PROXIMAL PORTION OF HUMERUS (TYPE) OF *DENDROCYGNA EVERSANA*, ANTERIOR VIEW. (NAT. SIZE.)

external point slightly projecting; fossa subtrochanterica deep, excavated so that walls are thin, perforated internally by a pneumatic foramen; outer margin of crista superior slightly broken; crest sloping in a slightly concave line from base of external tubercle, becoming thinner, and then passing down to merge with side of shaft; point of tendinal attachment elongate, somewhat curved, with concave side outward, terminating proximally at highest point of crest, ending distally above lower end of ridge, the crest projecting at an angle of 70° with the shaft; coraco-humeral groove extending at an angle across lower part of base of humeral head toward outer margin of bone, shallow and broad, illy defined internally, becoming impressed and narrowed at incisura capitis, and terminating near margin of bone below inferior tubercle, where the straight walls forming it meet at the bottom in an acute sharp angle; bicipital surface rounded, slightly elevated toward upper side, limited on posterior, inner

margin by a slight line, but with no distinct bicipital groove; deltoid groove broad and poorly marked; lower margin of crista inferior meeting shaft at a sharp, slightly obtuse, angle.

Measurements in millimeters.—Length from head to nutrient foramen 38.2; greatest breadth of head 15; transverse diameter of shaft at nutrient foramen 4.7; distance from outer bicipital surface to end of tuberculum inferior 7.7;

Range.—Upper Pliocene: Known only from type locality, 2 miles south of Benson, Arizona.

Remarks.—In studying the present specimen I have had available skeletons of the following species of the genus *Dendrocygna*: *D. autumnalis*, *D. bicolor*, *D. arborea*, and *D. arcuata*, all save *arborea* represented by two or more specimens. Modern tree-ducks offer so many anomalies in distribution—the species *D. bicolor* for example

ranging now in South America, southern North America, southern Africa, India, and Burma—that, lacking skeletons of some of the species of the genus, I should have hesitated to describe this fossil bird as new were it not that it represents a species distinctly smaller than any of those known to-day. The dimensions of the fossil humerus are less than those of *D. arcuata*, that species and *D. javanica* being the smallest of modern *D.* representatives of the group.

A fossil tree-duck, *Dendrocygna validipennis*, has been described by C. W. de Vis¹ from what are said to be “post-pliocene deposits” in Queensland, Australia. This species need not figure in the present comparison as it also is a larger form, compared by the describer with the Australian tree-duck, now known as *Leptotarsis eytoni*. If *validipennis* is correctly allocated as a tree-duck, as seems from the figures and description to be the case, then it is probable that the skeleton of *Leptotarsis* offers some difference from that of *Dendrocygna* in the form of the internal and external tubercles, the crista superior and the head of the shaft. Material is not at hand to verify this supposition.

In the diagnosis given for *Dendrocygna eversa* comparison has been made with *D. bicolor*. The fossil *D. eversa*, differs from all the tree-ducks at hand (as listed above) in smaller size, position of deltoid ridge, and angle formed by crista inferior at junction with side of shaft. In the other diagnostic characters assigned *eversa* agrees with *arborea* in sharp ridging of upper end of shaft, and with *arcuata* and *arborea* in the amount of overhang of the humeral head.

Dendrocygna eversa will stand for the present as the smallest of known tree-ducks.

The humeral head in *Dendrocygna* resembles that of geese (*Branta*, *Anser*, *Chen*, and *Philacte*) and differs from ducks (*Dafla*, *Marila*, *Erismatura*, *Histrionicus*, *Oidemia*, etc.) and Mergansers (*Mergus* and *Lophodytes*) in that when the bone is viewed from in front no overhang of the caput humeri is evident in the cleft of the incisura capitis, in the compressed ridge at the upper end of the shaft on the posterior side, and in general narrow form of the humeral head. *Dendrocygna* differs from the geese mainly in the relatively lessened bulk of the caput humeri, in the position of the nutrient foramen nearer the middle of length of shaft, and in the sharper angle on the margin of the crista superior, differences more or less intangible, that do not hold definitely for all the genera of geese as a group. *Anser albifrons* in particular strongly suggests *Dendrocygna*.

¹ Proc. Linn. Soc. New South Wales, ser. 2, vol. 3 (for 1888), 1889, p. 1282, pl. 34, figs. 5a, 5b, and 6.

BRANTA MINUSCULA, new species.

Characters.—Humerus similar to that of *Branta canadensis* (Linnaeus) but size small (smaller than in subspecies *B. c. minima* Ridgway), angle of *caput humeri* at dorsal end of *incisura capitis* abrupt, nearly a right angle, forming a distinct shoulder instead of a gradual slope; head of humerus proportionately more narrow, with external fossa relatively larger; external tubercle reduced.

Description.—*Type*, Cat. No. 10548, U.S.N.M., proximal half of right humerus (figs. 3 and 4), collected by J. W. Gidley, April, 1921, in quarry on Sec. 22, T. 17 S., R. 20 E., 2 miles south of Benson, Arizona. Upper Pliocene.



FIG. 3.—PROXIMAL PORTION OF HUMERUS (TYPE) OF BRANTA MINUSCULA, POSTERIOR VIEW. (NAT. SIZE.)

Shaft (badly splintered but restored) with slightly indicated sigmoid flexure; expanded broadly to support humeral head, an acute ridge extending to base of *caput humeri* at external margin on posterior face; deltoid ridge beginning on side of bone well below lower margin of *crista superior*, proceeding with a slight sigmoid flexure inward toward center of shaft, with an abrupt concavity beyond center of length where line is very faint, terminating finally as an elongate tubercle set at a slight angle external to median line of shaft, separated by a space of 4 millimeters from the base of the external tubercle; ridge on end of shaft low with sides meeting at a sharply pointed but obtuse angle; the head of the humerus impressed below *caput humeri*, this impression sharply delimited proximally by a line continuous with the ridge on shaft, and excavated slightly under lower margin of *caput humeri*; *tuberculum externum* heavy, elevated, external margin slightly curved, set with outer margin not projecting laterally beyond external line of shaft; tubercle excavated on posterior

face; external side straight, forming a right angle with posterior face; proximal end projecting slightly beyond base of *caput humeri*; *caput humeri* relatively low, with elongate, rounded proximal surface, rounded in outline on anterior margin, angulated posteriorly toward *incisura capitis*, with whole posterior margin forming an overhang especially prominent toward *incisura capitis*; inferior tubercle with point missing; *incisura capitis* deep, narrow, ending as a simple notch on anterior face, but curving externally on posterior side, where it is overhung by internal angle of *caput humeri*; *fossa subtrochanterica* moderately large, with a slight shelf marking lower margin of *crista inferior* above which there is

a slight elevation serving as a raised threshold for the main fossa; opening of fossa rudely ovate with internal pneumatic foramina; projecting angle of crista superior missing; base showing impressed curved line of muscle attachment; bicipital surface broad, regularly rounded, delimited posteriorly by a curving, faintly impressed, but distinct bicipital groove; crista inferior with rounded outer margin forming a clean cut angle at junction with shaft; deltoid groove broad, shallow, poorly marked; coraco-humeral groove broad, shallow, indistinctly delimited until it reaches level of incisura capitis, where it becomes suddenly narrowed with elevated margins, and terminates as a deep cleft, with walls meeting at bottom in an acute angle on lower margin of inferior tubercle, the external end of groove open without impression; a slight overhang of proximal wall beyond incisura capitis; a slight excavation between tuberculum externum and base of caput humeri.

Measurements in millimeters.—Transverse diameter of shaft below crista superior 9; width of head from external point of bicipital surface to line of external margin of tuberculum externum 21.7 (projecting points of bone broken away in such a manner as to make taking of definite measurements difficult).

Remarks.—This bird is remarkable chiefly for its size, as it seems from the fragment available to represent a form smaller than the smallest living representatives of *Branta canadensis*. It is a member of the group containing the Canada goose and is not a sea goose or brant (*Branta bernicla* group) as these differ from *canadensis* in that they lack the impressed space on the head of the shaft below the caput humeri, a character in which brant resemble *Oenanthe* and *Anser*. *Branta minuscula* would seem to have been but a trifle larger than our large ducks.

Family ANATIDAE (indeterminate).

Three fragmentary coracoids represent as many species of duck-like birds that may not be identified with certainty. The largest of these three, a nearly complete coracoid, represents a bird about as large as a canvasback, and may have been a member of the subfamily Anserinae. The two others seem to belong in the subfamily Fuligulinae, and appear to have come from birds somewhat smaller in body than the lesser scaup or harlequin ducks. All three specimens come from the quarry 2 miles south of Benson.

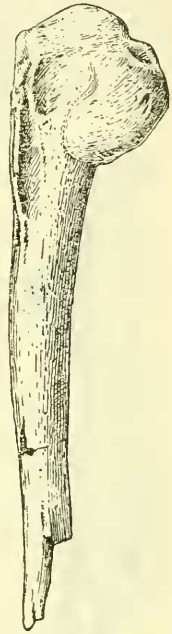


FIG. 4.—PROXIMAL PORTION OF HUMERUS (TYPE) OF *BRANTA MINUSCULA*, ANTERIOR VIEW. (NAT. SIZE.)

Family MELEAGRIDAE.

AGRIOCHARIS, species.

A broken right tarso-metatarsus (fig. 5) secured in a quarry two and one-half miles south of Benson near the Gum Ranch, March 8, 1921, represents an ocellated turkey, a genus not previously recorded within the limits of the United States. The specimen consists of the lower half of the tarso-metatarsal bone of an adult male, with the middle trochlea complete, but with both lateral ones broken away. Through the kindness of Dr. Loye H. Miller, I have been able to examine a tarso-metatarsus of a modern *Agriocharis ocellata*, and have also had available a figure of that species taken from a photograph published by Dr. R. W. Shufeldt.²



FIG. 5. — BROKEN TARSO-METATAR-SUS OF AGRIO-CHARIS, SPECIES, ANTERIOR VIEW. (NAT. SIZE.)

The fossil bone, while not absolutely identical with the specimens available for comparison, agrees closely with them. The slight differences that it offers consist mainly in slightly different sculpturing of the sides of the median trochlea, characters that may perhaps vary with age. Should further material become available it is possible that the fossil may be described as specifically distinct from the modern bird.

At the present period the ocellated turkey is found only in Guatemala, Honduras, Campeche, and Yucatan, where it ranges in tropical regions. The present record for southern Arizona is a distinct addition to what we consider the typically North American avifauna, and marks a considerable extension in the known range of the genus in question. As this would seem to indicate a former distribution throughout much of Mexico, further records will be awaited with considerable interest. Especial attention should be paid to scrutiny of turkey bones from caverns and from ancient sites of Indian villages, as it is barely possible that *Agriocharis* may have survived in the north until comparatively recent times.

Identification of this fossil from Arizona led naturally to examination of the remarkable species *Parapavo californicus* L. H. Miller, described from the Pleistocene asphalt beds at Rancho La Brea. Three tarso-metatarsi (the type bone in this species) were loaned for this purpose through the kindness of Dr. C. Stock, of the University of California. The species in question was first described by Doctor

² *Aquila*, vol. 21, 1914, pl. 14, fig. 52.

Miller as *Pavo californicus*.³ Later, when an abundance of additional material became available Doctor Miller,⁴ in an excellent account of his further studies of the species, proposed for it the generic name of *Parapavo*, and compared it with *Agriocharis*. His careful and lucid account of the characters of this bird leave nothing to be added in the way of description.

From examination of the tarsal bone it is my opinion that *Parapavo* is a meleagrine form intermediate in its characters between modern *Meleagris* and *Agriocharis*. The three, though evidently closely allied, offer distinctions of generic value. The characters marking adult males may be conveniently shown in form of a key.

a¹. Distance from lower margin of spur core to distal end of middle trochlea 50 mm. or more; the two lateral trochleae less produced posteriorly beyond axis of shaft; bone stronger, heavier.

b¹. Intermediate hypotarsal ridge absent or but slightly developed; inner border of middle trochlea produced proximally on posterior face as a sharp ridge that extends upward toward shaft, beyond upper end of groove on face of trochlea; head of bone proportionately broader and heavier.

Meleagris.

b². Intermediate hypotarsal ridge well developed; inner border of middle trochlea cut away on posterior face, not produced in a proximally extended ridge; head of bone proportionately more slender.

Parapavo.

a². Distance from lower margin of spur core to distal end of middle trochlea 45 mm. or less; the two lateral trochlea more produced posteriorly beyond axis of shaft; bone slighter, more slender.

Agriocharis.

It will be noted that *Parapavo* has been grouped above with *Meleagris*. Six characters have been found in which these three genera offer points of difference. In three of these *Parapavo* agrees with *Meleagris*, and in three with *Agriocharis*. One character in each group is based on size and may be disregarded as of slight importance. Of the others the two that unite *Parapavo* and *Meleagris*, that is, elevation of spur core and position of the lateral trochlea with regard to the shaft seem of greater weight than the two that join *Parapavo* to *Agriocharis*, namely the presence of an intermediate hypotarsal ridge and the conformation of the inner border of the middle trochlea. The first two are deemed of greater importance since they are established when the tarsal elements coalesce during development of the young individual, while the others, less primitive, are more subject to modification through subsequent stress or strain as the bird gains in age.

The two species of modern peacocks, *Pavo muticus* and *P. cristatus*, members of the family Phasianidae, and the two modern

³ Univ. Calif., Publ., Bull. Dept. Geol., vol. 5, August, 1909, p. 285.

⁴ Idem, vol. 9, Mar., 10, 1916, pp. 89-96.

species *Meleagris gallopavo* and *Agriocharis ocellata* of the family Meleagridae differ constantly from one another in the relative position of the trochleae of the tarso-metatarsus. In the peacocks the two lateral trochleae have less elevation above the middle trochlea, while in the turkeys the elevation of the lateral trochleae, particularly that of the inner one, is much more pronounced. *Parapavo*, in this respect is similar to *Meleagris* and *Agriocharis*. The relative position of these articular prominences is established during ossification and ankylosis when the animal is in a very immature stage of development. Of necessity therefor this character must be considered a basic one in the separation of major groups, and must carry much more weight than, for example, the presence or absence of an intermediate hypotarsal line, where the play of important tendons may alter considerably the stresses that serve to form such a ridge.

In my opinion *Parapavo* is a true meleagrine form and any characters that may seem to connect it at all closely with the peacocks are superficial and due to some parallelism of development. In confirmation of my belief in this regard I may add that though the intermediate hypotarsal ridge is usually absent in *Meleagris gallopavo* I find it developed to a greater or less extent in eleven of thirty-four specimens of varying ages (all feral individuals). Its presence or absence can not therefore be considered weighty in establishing group relationships.

Family ODONTOPHORIDAE.

COLINUS, species.

The distal end of a right tarso-metatarsus secured 2 miles south of Benson is similar to that of *C. virginianus*, but has the foramen situated lower down, nearer the notch between middle and outer trochleae.

The genus *Colinus* is represented in Mexico and Central America by several species and subspecies whose skeletons are not at present available, so that it is not practicable to identify the present scrap of bone further than to state that it represents a quail similar in size to our familiar bobwhite, but probably of another species. The fossil fragment differs from *Callipepla* in smaller, more narrow middle trochlea, while from both *Colinus virginianus* and *Lophortyx gambeli* it is distinguished by the low position of the external foramen.

Family ODONTOPHORIDAE (indeterminate).

The head of a right humerus secured 14 miles southeast of Benson in March, 1921, belongs in this family, but may not now be identified through lack of skeleton material of the quails of Mexico and Central America. This broken humerus is as large and robust as

that of *Oreortyx*, but has characters that seem to ally it more closely with *Colinus*. It is possible that it belongs in one of the genera at present of more southern range, or it may come from a genus now extinct. In either case, it is a representative of a group not known in our modern fauna north of the Mexican border.

Family RALLIDAE.

GALLINULA, species.

The distal ends of two tibiae secured in the collecting locality 2 miles south of Benson average a little large, but otherwise agree fairly well with material of the common gallinule (*Gallinula chloropus*) at hand.

Distinctions between the lower end of the tibia in *Fulica* and *Gallinula* are slight, and in a large series the characters available inosculate, so that there is no hard and fast line between the two genera. Recourse must be had to the sum of all in deciding on the identity of these intermediate individuals. In general, in *Fulica* the internal condyle is heavier, the articular surface on the posterior face of the bone broader in proportion to its length, the intercondylar sulcus broader, and the indentation near the center of the raised margin of the internal tubercle smoother, less abrupt than in *Gallinula*. *Fulica*, in addition, may be larger, though large gallinules may exceed small coots in size.

Family SCOLOPACIDAE.

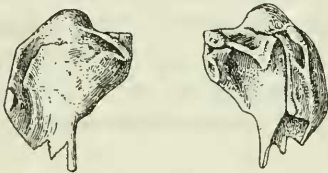
MICROPALAMA HESTERNUS, new species.

Characters.—Head of humerus similar to that of *Micropalama himantopus* (Bonaparte) but with caput humeri smaller, less rounded, more pointed at tip, on under surface forming a more oblique angle with shaft; lower end of coraco-humeral groove straight, not curving distally, so that end of groove comes nearer to tuberculum inferior.

Description.—*Type*, Cat. No. 10550, U.S.N.M., head of right humerus (figs. 6 and 7), collected by J. W. Gidley, April, 1921, in quarry 2 miles south of Benson, Arizona. Upper Pliocene.

Crista superior placed at nearly a right angle to lateral diameter of bone, triangular in lateral outline, with proximal margin indented below highest point, then swelling slightly before joining base of caput humeri; point located just above lower, distal margin of internal crest on opposite side of bone, inclined slightly from perpendicular toward shaft; depression marking attachment for pectoralis major extending to center of shaft; caput humeri rounded, elevated and narrowed toward highest point; coraco-humeral

groove shallow and slightly marked below head, becoming much deeper with abrupt sides and rounded bottom beyond line of incisura capitis to end abruptly with steep terminal wall at level of outer margin of tuberculum inferior, passing in a nearly straight line across humerus at slightly less than a right angle (distally) to axis of shaft; proximal margin of groove opposite incisura capitis slightly arcuate with a slight overhang; groove for deltoid beginning at anterior margin of insertion for pectoralis major, and extending as a deep groove with abrupt margin on bicipital side, where there is an overhang on lower half, to become more shallow and merge in a curve with coraco-humeral groove; bicipital surface shorter than broad, irregular, delimited below by an impressed line extending transversely from lower margin of inferior crest in a slight curve toward distal end of deltoid groove to end near center of shaft; tuberculum inferior triangular in outline, elevated, square at point; shaft on lower surface compressed to form a sharp, angular line extending to base of caput humeri, excavated on lower side, in an elliptical depression below caput humeri where the margin of the humeral head



FIGS. 6 AND 7.—HEAD OF HUMERUS (TYPE) OF *MICROPALAMA HESTERNUS*, ANTERIOR AND POSTERIOR VIEWS. ($\times 2$)

forms a slight overhang; tuberculum externum elongate, prominent, excavated at median point so that the surface is concave, extending proximally to margin of bone, and forming a slight anterior projection at base of caput humeri; fossa subtrochanterica sloping gradually from side of shaft, comparatively shallow, though overhung by elevated tuberculum inferior; no pneumatic foramen; a sharp compressed ridge extending inward obliquely to shaft, with a low rounded ridge passing from point of junction with shaft to base of overhanging caput humeri, the latter line delimiting a small concavity, rudely triangular in outline, at base of incisura capitis, and forming the inner margin of the median depression below the articular head; viewed laterally the inferior tubercle slightly hooked; posterior line of crista inferior joining shaft at an oblique angle, with outer margin shallowly concave near center.

Measurements in millimeters.—Length from outer end of bicipital groove to end of caput humeri 7.1; greatest breadth of head 7.7; height of crista superior above lower margin of shaft 3.5.

Range.—Upper Pliocene: Known only from type locality 2 miles south of Benson, Cochise County, Arizona.

Remarks.—This species represents a sandpiper very closely allied to the modern stilt sandpiper (*Micropalama himantopus*) that at the present time breeds from near the coast of Mackenzie for an indeterminate distance southward, and ranges in migration through

the western part of the Mississippi Valley, Central America, and the West Indies, south into South America. It is recorded in small numbers from the Atlantic coast, and is casual in occurrence in British Columbia. The species has not been recorded from Arizona.

The discovery of *Micropalama hesternus* is interesting as the stilt sandpiper has stood as the representative of a monotypic genus. The differences between *hesternus* and *himantopus* as shown by the head of the humerus are slight but appear constant as a series of five humeri of *M. himantopus* at hand seems sufficient to illustrate individual variation in that species. It is possible that *M. hesternus* may have represented a well-marked western form of *M. himantopus*. On this supposition the case of the stilt sandpiper would be similar to that of *Macrorhamphus griseus*, *Catoptrophorus semipalmatus*, and *Tringa solitaria*, shore birds that to-day are represented by eastern and western subspecies.

The identification of *hesternus* as a member of the genus *Micropalama* led to a review of the humerus in all of our Charadriiformes and brought out an interesting similarity in the form of the humeral head in the turnstones (*Arenaria*) and the stilt sandpiper a similarity that is astonishing as the two groups are not closely allied (usually they are placed in separate families), and to be explained probably as convergent evolution. So close are the two in form (*Arenaria* has a longer, heavier humerus) that it was only after considerable study that the following key was worked out to distinguish the two genera. The differences outlined are largely relative, adding to the difficulty in distinguishing the two from disparity in size of the humerus in the two groups.

a¹. Coraco-humeral groove more shallow, less sharply defined at inner end, inner part of proximal margin straight, with little or no overhang below incisura capitis; anterior outer margin of fossa subfrochanterica below tuberculum inferior less hooked; tuberculum inferior relatively less prominent; ridge of tuberculum externum nearly straight with very slight median excavation.

Arenaria.

a². Coraco-humeral groove deeper, more strongly impressed at inner end, anterior (proximal) margin slightly arcuate with distal overhang; angle below tuberculum inferior more hooked; tuberculum inferior relatively more prominent; ridge of tuberculum externum excavated in median portion.

Micropalama.

Family COLUMBIDAE.

CHLOROENAS MICULA, new species.

Characters.—Distal part of tarso-metatarsus similar to that of *Chloroenas fasciata* (Say), but considerably smaller; external projection (ala interna) on inner trochlea more acute; inner trochlea less deeply grooved on posterior surface; inner margin with outline show-

ing no sinuation; middle trochlea with inner and outer margins nearly parallel, very slightly convergent at upper end on posterior face; outer trochlea separated from middle by relatively broader groove.

Description.—*Type*, Cat. No. 10549, U.S.N.M., distal end of right tarso-metatarsus, (figs. 8 and 9) collected by J. W. Gidley, March, 1921, in quarry 14 miles southeast of Benson, Ariz. Upper Pliocene. Lower end of shaft slightly rounded anteriorly, though broad and comparatively plane, expanded to support the distal trochleae; a distinct external groove that becomes deeper to terminate in the inferior foramen, well above the external intertrochlear sulcus; shaft expanded more toward outer than toward inner side; external trochlea compressed, with anterior external angle cut away in an abrupt slope that forms an angled articular facet for fourth toe, with a very faint central sulcus, and an equally slight basal excavation to receive the end of the facet of basal digit of the outer toe; external face of external trochlea flattened but slightly rounded (external posterior margin imperfect); external intertrochlear sulcus moderately deep with rounded bottom and very slightly divergent



FIGS. 8 AND 9.—LOWER END OF TARSO-METATARSUS OF *CHLOROENAS MICULA*, ANTERIOR AND POSTERIOR VIEWS. ($\times 2$.)

sides, continued as a well-marked groove that passes back to become continuous with the groove containing the inferior foramen; middle trochlea moderately strong, with sides whose faces are excavated to form distinct median concavities; in lateral outline evenly rounded on free portion to form an ellipse with posterior side slightly flattened; a rather broadly excavated median groove that

merges with the shaft posteriorly and on anterior face terminates in a distinct pit; on the posterior side with external margin projecting farther, and extending somewhat higher on shaft, than inner; inner margin lower, converging slightly at upper end toward center of trochlea; internal digital trochlea, viewed from in front, broad, with surface rounded; internal face flat, projecting posteriorly well beyond middle trochlea, and placed correspondingly less far forward on anterior face, where the middle trochlea projects anterior to it; posterior face with a sharp posterior projecting ridge, with a very slight sulcus at its base; a distinct winglike inner tubercle or ala interna projecting as a rounded, somewhat flattened cone at a right angle from the outer face of this posterior portion; ala interna well separated from main trochlea; posterior face of shaft slightly excavated in center, forming a longitudinal trough with rather sharp margins.

Measurements in millimeters.—Greatest breadth across trochlea 5.4 mm.; transverse diameter of inner trochlea, including ala interna 2.0 mm.; transverse diameter of middle trochlea 1.5 mm.; transverse diameter of external trochlea 1.2 mm.

Range.—Upper Pliocene, known only from type locality, 14 miles southeast of Benson, Ariz.

Remarks.—The present species was a small pigeon apparently more or less similar in size to the modern mourning dove. The metatarsus in the group of what may be termed the columbine pigeons, formerly all embraced in the broad genus *Columba*, has the inner trochlea less elevated and the trochlea as a whole shorter and stronger than in related groups. *Chloroenas micula* suggests *Melopelia asiatica* strongly in appearance but may be distinguished by the characters just cited and by other minor points. *Zenaida* is distinguished by the slight depth of the incisions between the trochlea, while *Zenaidura* is peculiar in the slight development of the winglike process on the internal trochlea. *Scardafella* and *Chamaepelia*, genera that in spite of their small size are suggestive of affinity to the fossil, are to be distinguished by the elongate outer face of the external trochlea which is considerably longer than broad.

The affinities of *micula* are with *Chloroenas* and not with the West Indian species now segregated in the genus *Patagioenas*. The distinction in the lower end of the tarso-metatarsus between these groups may be summarized conveniently in the form of a key:

*a*¹. Inner trochlea with winglike projection smaller, less swollen, not projecting so far posteriorly; junction with main body of trochlea marked by a distinct depression.

Patagioenas squamosa.

Patagioenas leucocephala.

*a*². Inner trochlea with winglike projection relatively larger, more swollen, projecting farther posteriorly; junction with main body of trochlea indicated if at all by a very slight depression.

Chloroenas fasciata.

Chloroenas inornata.

Chloroenas micula.

Family CORVIDAE.

CORVUS, species.

The distal portion of a right tibio-tarsus secured two miles south of Benson belongs to a small raven of the *Corvus corax* group, closely related to, and perhaps identical with, *C. shufeldti* from the Fossil lake deposits of Oregon. The latter species, described originally by Dr. R. W. Shufeldt as *Corvus annectens*,⁵ a name unfortunately pre-occupied by *C. annectens* Brüggemann⁶ was subsequently renamed *Corvus shufeldti* by Sharpe.⁷

In Doctor Shufeldt's original description his form, based on a right tarso-metatarsus, is said to resemble *C. corax* but to be smaller, a

⁵ Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 9, 1892, p. 419, pl. 15, figs. 14-16.

⁶ Abh. Naturwiss. Ver. Bremen, vol. 5, April, 1876, p. 75.

⁷ Hand-l. Gen. Spec. Birds, vol. 5, 1909, p. 599.

statement fully born out by examination of a beautifully made cast of the type specimen, secured through the courtesy of Dr. W. D. Matthew of the American Museum of Natural History. Though somewhat similar in size to the modern white-necked raven, *Corvus cryptoleucus*—a species now found in semi-desert regions from western Texas and southeastern California, south to Guanajuato and Michoacan, that in the last century ranged north into western Kansas and Nebraska—*shufeldti* has the strong, robust form that characterizes *Corvus corax*, and is allied to it rather than to *cryptoleucus*.

The tibio-tarsus secured near Benson is also of the *Corvus corax* type, though it represents a bird only about as large as a common crow, *Corvus brachyrhynchos*. Careful comparison shows that this specimen comes from a bird slightly smaller than the type of *shufeldti*. The difference in size between the two is, however, within the possible limit of sexual variation, as shown by a study of a series of *Corvus corax* and *C. brachyrhynchos*. In other words the type of *shufeldti* might represent a male and the Pliocene bird a female of the same species, a possibility not in conflict with the geological evidence in the case, since there would be nothing to prevent a species (represented by the Benson specimen) that existed in the upper Pliocene from extending its range during the milder climate of the first interglacial period (when it is supposed that the Fossil and Silver Lake deposits were formed) to the region in south-central Oregon where the type of *shufeldti* was secured. On the other hand the Benson specimen may represent a distinct species, a matter that is left in abeyance until further material may be available.

Following is a detailed description of the tibio-tarsus secured by Doctor Gidley: Inner and outer malleoli nearly similar in form and size but the inner one slightly wider in transverse diameter on external face; intercondylar sulcus broad, divided by a low but well marked ridge that begins on the posterior face at the level of the upper margin of the condyles and passes down to end abruptly at the lowest point of the sulcus, where it is abruptly delimited by the margin of the intercondylar fossa, so that it does not extend around on anterior face of sulcus; intercondylar fossa, for the reception of the intercondylar process of the tarso-metatarsus, broad and well excavated, including most of anterior face of sulcus with a distinct ridge at level of upper third, below which the fossa has its deepest excavation; inner condyle set at a slight angle so that it flares outward, on the anterior side thickened toward the upper end, where the inner surface, toward the intercondylar sulcus, is smoothly rounded, extended as a low ridge bounding the intercondylar sulcus around on to the dorsal face of the bone; external face

roughly rounded in outline, flattened slightly from above downward, with the external margin raised slightly so that the external face is concave; posterior proximal margin deflected inward in a direct slope to merge with the shaft; anterior proximal margin projected farther beyond level of shaft than posterior; internal ligamentary tubercle elevated as a low flattened cone with lower margin above center of outer face of condyle, placed in a line with the anterior margin of the shaft; outer condyle nearly on a plane with the outer face of the shaft, with the anterior margin thickened, rounding into intercondylar sulcus; posterior margin becoming thin and swinging in to merge with the shaft at the same level as that from the internal condyle; outline of external condyle roughly elliptical, with a raised margin all around so that the external face of the bone is concave; a very slight almost imperceptible eminence slightly above center; shaft in cross-section elliptical near center, rounded on posterior side, becoming flattened as it proceeds downward on anterior face; distal end somewhat expanded, distinctly flattened on anterior side; supratendinal bridge (above extensor digitorum communis) moderately broad, passing obliquely from a point slightly external to center of shaft to an elevated inner prominence on the antero-internal end of the shaft above the outer condyle; a distinct sulcus on outer anterior angle for the passage of the peroneus longus; margins of this sulcus raised as distinct crests, the external one being more acute than the inner one; the sulcus passing at a slight angle outward; a *linea aspera* marking the peroneal muscle passing upward from outer of these crests for a distance of 15 millimeters; on inner anterior margin of shaft a *linea aspera* that marks the extensor digitorum muscle, this line forming the point of junction of inner and anterior faces of shaft; this line terminates in a thin raised crest for the attachment of the inner end of the oblique ligament (below which passes the tendon of the tibialis anticus); external tubercle for oblique tendon a crest above upper external margin of the tendinal bridge for the extensor digitorum communis.

Measurements of the specimen are as follows: Condylar breadth, 9.4 mm.; transverse diameter of shaft near center (of complete specimen), 4.5 mm.; transverse diameter of internal condyle, 8.7 mm.; transverse diameter of external condyle, 7.6 mm.; distance from center of tubercle for internal ligament to lower margin of internal condyle, 5 mm.

In the genus *Corvus* the lower end of the tibio-tarsus in the ravens is distinguished by the prominent high, sharp crest that extends well up on the inner side of the shaft, with the groove for the *peroneus profundus* relatively broader and placed at a higher elevation. In this *Corvus cryptoleucus* agrees with *C. corax*. The crows, on the contrary (*C. brachyrhynchos* and *C. ossifragus*), have the

crest on the inner side of the shaft lower and less prominent, with the external face below distinctly rounded and the groove for the *peroneus profundus* relatively narrower, less elevated.

The specimen secured by Doctor Gidley is the oldest representative of its genus at present known from North America.

Family FRINGILLIDAE.

JUNCO, species.

The premaxilla of a small finch secured 2 miles south of Benson agrees with that of the genus *Junco*, and among modern groups of snowbirds is closely similar to that of *Junco hyemalis*. From other allied American finches of modern times it is distinguished by minute differences in outline sufficient to separate it definitely. Fossil passeriform birds have been reported seldom in North America, and the present record, save for *Palaeospiza bella* Allen, whose fringillid affinity may be open to doubt, is the first account of a finch in the Tertiary.

Family FRINGILLIDAE (indeterminate).

Among scant passerine remains are three fragments representing finches that may not be identified save to family, tantalizing glimpses of ancient birds of this group that give mere suggestions of species concerning whose appearance we may only speculate. The distal end of an ulna, found 2 miles south of Benson, comes from a bird the size of a white-crowned sparrow. Another ulna, even more broken, of similar size, was secured at the site 14 miles southeast of Benson, and with it the proximal end of a left tibia that is almost identical with that of *Zonotrichia leucophrys*, both in size and in detail of structure. All of these bits represent species belonging in the group that Mr. Ridgway⁸ has designated as the Zonotrichiae.

Another broken ulna (secured 2 miles south of Benson) from a bird nearly as large and robust as a meadow lark is from a finch of another group.

⁸ Birds North and Middle America, vol. 1, 1901, p. 28.